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(54) Vacuum chucks

(57) In a vacuum chuck comprising a sub-table 7 having a grooved upper surface and holes 12 for connecting the grooves 11 to a vacuum pump, and a jig 14 located on the upper surface of the sub-table, the jig 14 comprises a sheet of porous material which has mechanical properties substantially similar to those of wood, but having no holes formed therethrough. The invention includes a method of operating a vacuum chuck wherein a sheet of porous material which has mechanical properties substantially similar to those of wood, and having no holes formed therethrough, is used as a jig. Preferably, the jig is made of medium density fibreboard.

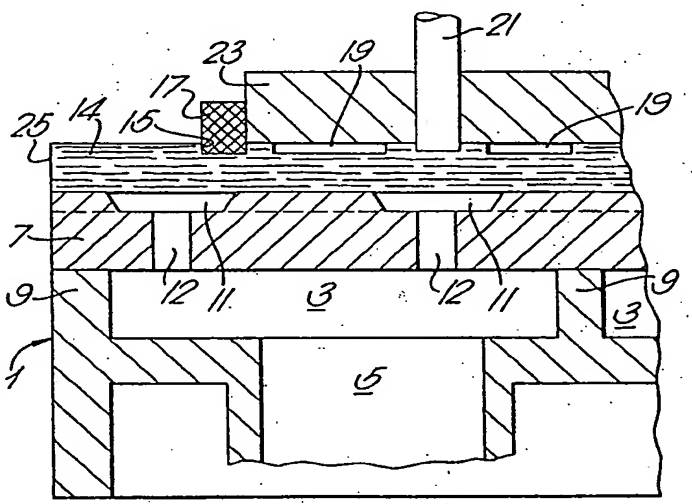

FIG. 1.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

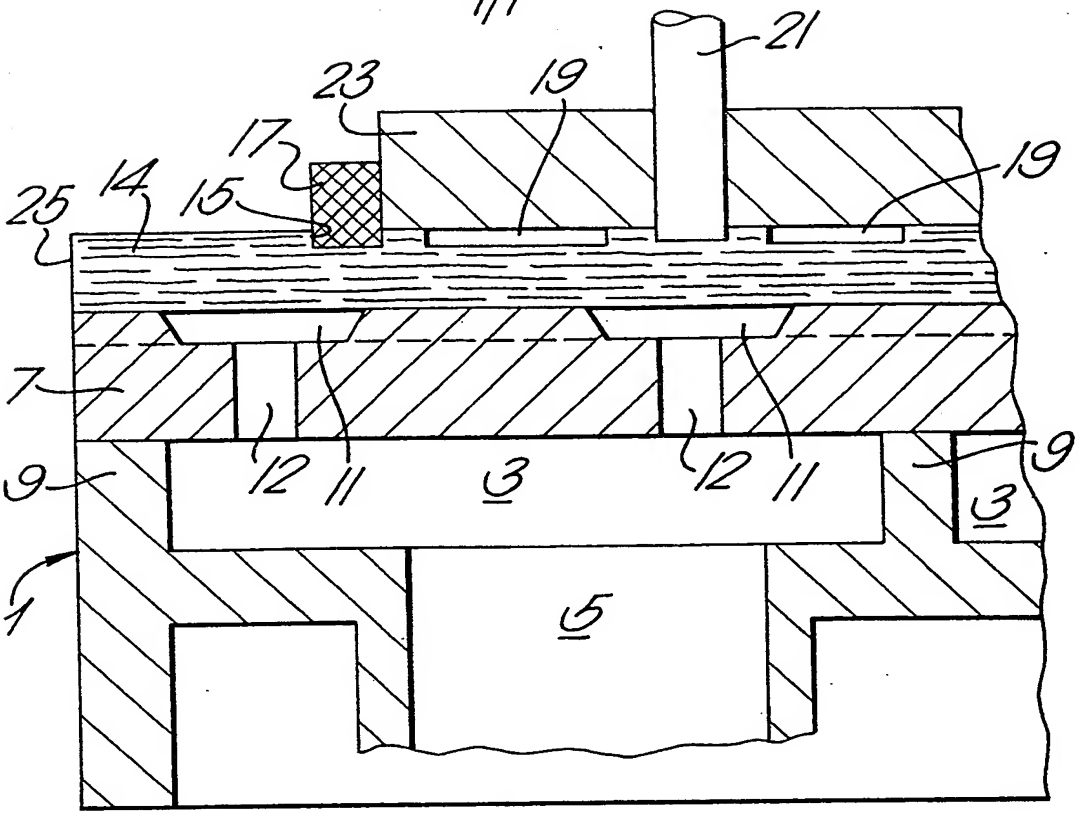
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FIG. 1.

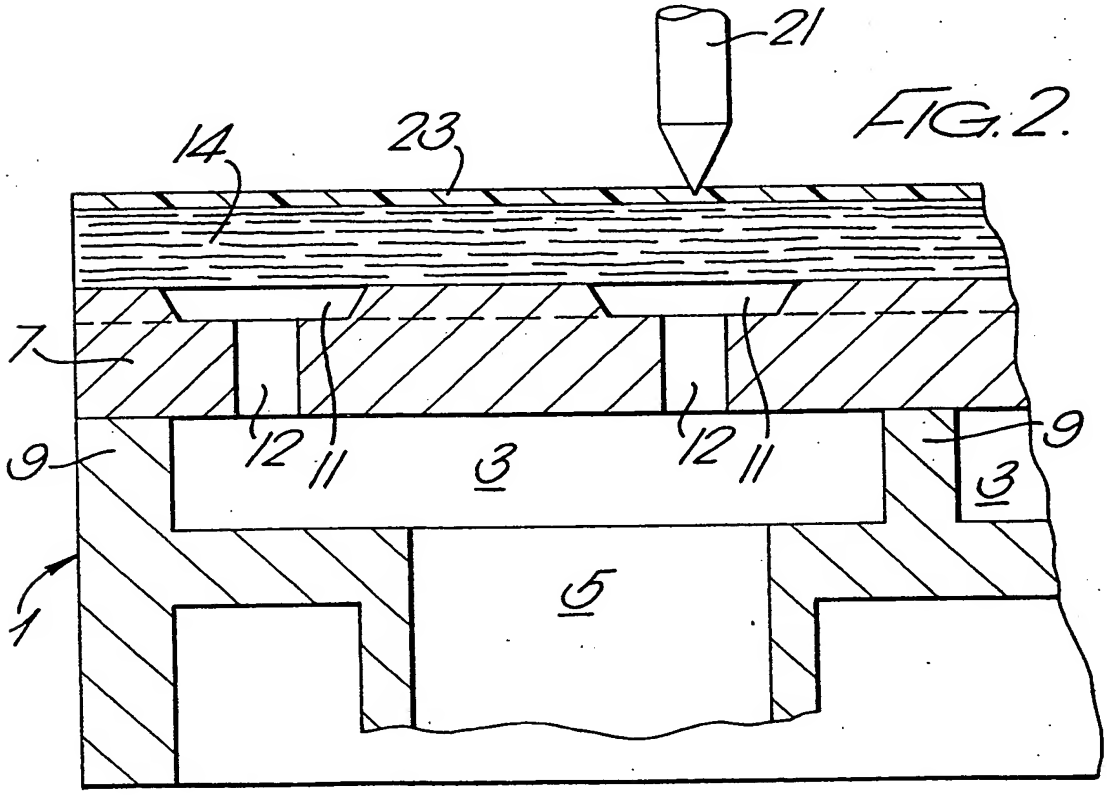
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FIG. 2.

SPECIFICATION

Vacuum chucks

The present invention relates to a vacuum chuck for use in holding a workpiece so that it may be worked on by a tool. It is envisaged that the vacuum chuck of the present invention will be of particular, but not exclusive, use in the furniture industry for the production of furniture components from timber or composite materials.

Vacuum chucks are well known in the furniture industry, and are used to hold sections of wood or composite boards in place so that they may be worked on by one or more tools to produce furniture components. Such tools include multiple carvers, routers, shapers, drum sanders, drill presses, profilers, lathes, polishers, rosette cutters, boring machines, and any of the other tools commonly used in the industry. The tool may be manually, automatically or computer controlled.

Vacuum chucks can also be used in other industries, for instance in the metal working industry, to hold metal workpieces for drilling, grinding, cutting or profiling, in the printing industry, for holding a substrate to be screen printed in place below a screen printing machine, or in the graphics industry for holding paper, foils and films during draughting, plotting, engraving, or photographic work.

One known type of vacuum chuck is described in United States patent specifications Nos. 3 627 338 and 3 652 075. The vacuum chuck described in these specifications comprises a metal sub-table having formed in its upper surface a series of parallel intersecting grooves. Holes are formed at regularly spaced intervals in the sub-table to connect the grooves to a vacuum manifold which in turn is connected to a vacuum pump. The holes can be sealed by plugs. The sub-table is mounted on a machine table.

In use of this type of vacuum chuck an area of the sub-table is sealed off by placing a sealing strip of generally circular cross-section in the grooves which define the area. The sealing strip protrudes above the top surface of the sub-table. The holes outside the defined area are sealed by use of the plugs, but the holes within the area are left open. A workpiece is then placed on the sub-table over the defined area and vacuum is applied by the pump through the manifold. This evacuates the area within the sealing strip and the workpiece is held securely on the sub-table by atmospheric pressure and friction between the workpiece and the sealing strip and sub-table surfaces.

Another known type of vacuum chuck comprises a machine table which defines a large cavity. The cavity is connected to a vacuum manifold which in turn is connected to a vacuum pump. A sub-table is located on the top of the machine table. The sub-table is generally made of laminated resin-impregnated wood sometimes referred to as densified wood and has formed in its upper surface a series of parallel intersecting grooves. Holes are formed at regularly spaced intervals in the sub-table to connect the grooves to the cavity in the machine table.

Especially in the furniture industry, it is common practice to place a jig on the wooden sub-table and to place the workpiece on the jig. This is advantageous because it is possible to form in the jig grooves for receiving component locators for holding the workpiece in the correct orientation on the chuck. Alternatively they may be secured directly to the top surface without such location grooves. Use of such a jig is necessary if the tool is to pass entirely through the workpiece for instance, if the tool is a router, cutter or drill, since if the jig were not present, the tool would damage the chuck.

At present, such jigs are generally made of plywood and have the necessary grooves formed in their surface. In order for the vacuum to be able to hold the workpiece as well as the jig on the chuck, it is necessary to form a further series of holes in the jig to connect the upper surface of the jig to the grooves in the chuck.

In order to ensure that a good seal is formed between the workpiece and the jig, it is common practice to provide sealing strips, for instance in the form of flat strips of rubber, on the surface of the jig around any holes formed in the jig.

A disadvantage of using such jigs is that it is necessary to form the holes in the jig so that they connect with the grooves in the sub-table. This can be done either by accurately defining the positions at which the holes should be formed or by forming a large number of holes, only some of which will form the appropriate connections. The former method is time consuming and the latter is inefficient, and may not even produce the necessary connection. Hence the underneath surface of the jig is frequently provided with interconnecting grooves.

A further disadvantage is that, once the workpiece has been worked on and removed from the jig, there can be large amount of debris, such as sawdust, on the jig. Although most of this can be cleared away by an air jet or vacuum clearner, some of it inevitably finds it way into the vacuum system, and will eventually clog up the filters, which therefore need frequent changing if the efficiency of the chuck is to be maintained.

It is an object of the present invention to provide a vacuum chuck which at least in part overcomes these disadvantages.

According to the present invention, there is provided a vacuum chuck comprising:

a sub-table having a grooved upper surface and holes for connecting the grooves to a vacuum pump; and

a jig located on the upper surface of the sub-table, the jig comprising a sheet of porous material which has mechanical properties substantially similar to those of wood, but having no holes formed therethrough.

The material from which the jig is made should have mechanical properties similar to those of wood so that, if necessary, grooves for receiving component locators can be formed in the jig and so that, if necessary, the tool(s) can cut into the jig.

The material must also be porous, in that it must allow the passage of gases from one of its surfaces

to the opposite surface, but not allow the passage of debris, such as sawdust. It is therefore unnecessary to form any holes in the jig since vacuum can be applied to a workpiece located on the jig because of the porosity of the material.

The present invention also provides a method of operating a vacuum chuck wherein a sheet of porous material which has mechanical properties substantially similar to those of wood, and having no holes formed therethrough, is used as a jig.

A particularly suitable material is medium density fibre board. This is generally prepared from coniferous wood which has been defibrated to produce a fibrous, cotton wool-like mass. This mass is compressed and bonded together, generally using a synthetic resin, to form a sheet having mechanical properties similar to those of plywood or chipboard. It is in some respects better than either of these wood products because it can be readily profiled without disintegration at its edges. This material is being used to an increasing extent in the furniture industry and is well known in the art.

In some cases, the surface of the fibre-board is sealed by the resin either intentionally or unintentionally during the manufacturing process. If this is the case, the porosity of the board can be restored prior to its use as a jig by sanding away or otherwise removing the surface of the board.

By using a jig made of such a porous wood-like material, it is possible to avoid the need to form any holes through the jig. This eliminates the necessity for one step in the setting up of the vacuum chuck and also prevents to a large extent any contamination of the vacuum system by debris such as sawdust.

In using the vacuum chuck of the present invention, it may be necessary to use sealing strips to ensure that a good seal is formed between non-flat workpieces and the jig.

The jig may cover the whole or only part of the upper surface of the sub-table. If the jig only covers part of the upper surface, the holes in the parts which are not covered may be sealed by use of plugs or by laying non-porous material over these parts.

The workpiece may cover the whole of only part of the upper surface of the jig. If the workpiece only covers part of the upper surface, it may be necessary to cover the remaining parts of the upper surface with a non-porous material, such as a sheet of wood, paper or plastic. However, it has been surprisingly discovered that, where the workpiece covers a substantial part of the jig, it is not necessary to cover the remaining area of the jig, as a sufficiently good vacuum is formed to hold the workpiece in place without the need to seal the area around the workpiece. The proportion of the area of the jig which can be left unsealed will vary depending on the porosity of the workpiece and on the porosity of the jig material, but this proportion can be readily determined by the skilled person by trial and error experimentation.

It has also been surprisingly discovered that, by using such a porous wood-like material, it is possible to hold even some porous workpieces in place on the jig. For instance, it has proved to be possible to hold in place a workpiece of medium density fibre-board on a jig of medium density fibre-board. This is generally not possible using an ordinary jig in which there are holes.

It is envisaged that the vacuum chuck of the present invention can be used for holding in place not only wood but also metal and plastics substrates for any of the uses for which vacuum chucks are presently used. However, it is envisaged that the vacuum chuck of the present invention will be of particular use in the furniture industry for forming furniture components using any of the tools referred to above, or for the production of templates of the type described in our British patent specification No. 1 585 215.

Two embodiments of the vacuum chuck of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a cross-sectional view of part first embodiment of the vacuum chuck; and

Figure 2 shows a similar view of a second embodiment.

Referring now to Figure 1, the vacuum chuck comprises a machine table 1, which defines a number of cavities 3 which are each connected to a vacuum manifold 5. The manifolds 5 are in turn connected to a vacuum pump (not shown).

A sub-table 7 of laminated, resin-impregnated wood is supported on the flanges 9 of the machine table 1 which define the cavities 3. A mastic sealant placed on top of the flanges 9 ensures that there is a good seal between the machine table 1 and the sub-table 7.

The sub-table 7 has in its upper surface a series of parallel intersecting grooves 11 arranged to form a diamond, square or hexagonal pattern. At intervals along the grooves 11, holes 12 are formed in the sub-table 7 to connect the grooves 11 to the cavities 3.

A jig 14 of medium density fibre board such Caberwood (sold by Caberboard Ltd.) is supp d on the upper surface of the sub-table 7. The jig may have formed in it grooves 15 in which are placed component locators 17. Alternatively they may be screwed directly to the surface without the need of grooves. The jig also has formed in it grooves 19 which correspond to paths for tool 21, which in this case is a router.

A workpiece 23 comprising a sheet of chipboard is placed on the jig 14 in abutment with the locators 17. The workpiece covers the majority of the jig 14 but does not cover the area between the locators 17 and the edge 25 of the jig 14.

In use, the vacuum pump is turned on and produces a vacuum in cavities 3, holes 12 and grooves 11.

A vacuum is good enough to hold the workpiece 23 on the jig 14 even though there is an area of the jig 14 which is not covered by the workpiece 23.

The router is then operated to cut the workpiece 2 in whatever manner required. Thereafter the tool may be changed and further operations carried out on the workpiece 27. For instance, holes may be drilled or the surface may be sanded.

Thereafter, the vacuum is released, the workpiece 23 is removed, and any sawdust which is formed is blown or sucked away, without there being any danger of the sawdust entering the vacuum system through the jig 14. Another workpiece can then be located on the jig 14, and the operation can be repeated.

Referring now to Figure 2, there is shown a vacuum chuck similar to that shown in Figure 1. Therefore like parts are given like numbers and are not further described. This embodiment of the vacuum chuck differs from the Figure 1 embodiment is that the medium density fibre board jig 14 does not have in it any grooves. This embodiment is adapted to produce a template for checking on the setting up of a machine tool in accordance with the invention described in our British patent specification referred to above.

To this end, the workpiece 23 comprises a sheet of transparent, dimensionally stable plastic, such as that sold under the trade name "Mylar" (RTM) and the tool 21 is an ink pen or an engraving tool. Application of a vacuum to the chuck locates the sheet 23 accurately and securely on the jig 14. There is no distortion of the sheet 23 since there are no holes in the jig 14 to cause such distortion. The engraving tool is then operated to mark out on the surface of the sheet as required.

It can be seen that the vacuum chuck of the present invention substantially overcomes the disadvantages of known chucks which use jigs and also has surprising advantages which could not have been foreseen.

The vacuum chuck of the present invention has been described above by way of example only and it will be apparent to those skilled in the art that modifications and variations can be made without departing from the scope of the invention.

CLAIMS

1. A vacuum chuck comprising:

a sub-table having a grooved upper surface and holes for connecting the grooves to a vacuum pump; and

a jig located on the upper surface of the sub-table, the jig comprising a sheet of porous material which has mechanical properties substantially similar to those of wood, but having no holes formed therethrough.

2. The vacuum chuck of claim 1, wherein the jig has grooves for receiving component locators.

3. The vacuum chuck of claim 1 or claim 2, wherein the jig is made of medium density fibreboard.

4. A vacuum chuck substantially as hereinbefore described with reference to the accompanying drawings.

5. A method of operating a vacuum chuck wherein a sheet of porous material which has mechanical properties substantially similar to those of wood, and having no holes formed therethrough, is used as a jig.

6. The method of claim 5, wherein the jig has grooves for receiving component locators.

7. The method of claim 5 or claim 6, wherein the jig is made of medium density fibreboard.

8. The method of any one of claims 5 to 7, wherein sealing strips are used to ensure that a good seal is formed between a non-flat workpiece and the jig.

9. The method of any one of claims 5 to 8, and including the step of sealing any holes in the upper surface of a sub-table supporting the jig which are not covered by the jig.

10. The method of any one of claims 5 to 9, and including the step of laying non-porous sheet material over any parts of the jig which are not covered by a workpiece.

11. A method of operating a vacuum chuck, substantially as hereinbefore described with reference to the accompanying drawings.

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